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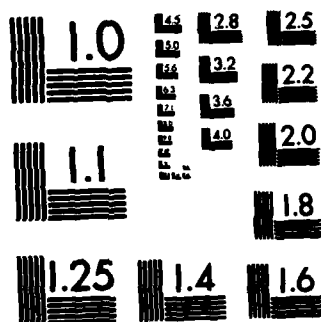
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LAMONT-DOHERTY GEOLOGICAL OBSERVATORY
OF COLUMBIA UNIVERSITY
Palisades, New York 10964

FINAL TECHNICAL REPORT

for

ONR Research Contract
N00014-83-K-2020

Deep Sea Drilling Project

by

R. N. Anderson

January 1985

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R.N. Anderson

Multi-channel, full waveform sonic logs were recorded as part of a complete suite of geophysical logs in Deep Sea Drilling Project borehole 556 into 37-million-year-old crust on the western flank of the Mid-Atlantic Ridge. The lithostratigraphy is unusual in that two highly altered serpentine fracture zones were encountered which crosscut relatively fresh gabbros. The fracture zones are each approximately 50 feet thick, are serpentinized at their margins, and grade into much less extensively altered gabbros at their centers.

Spectral analyses of windowed compressional and shear wave coda recorded by the multi-channel sonic log across this interval show that the fracture zones are not only strong energy attenuators, but are also acting as differential high-pass filters of the sonic energy. These fault zones can be easily identified from an apparent Q log derived from the change in energy across the receivers whereas neither V_p/V_s nor Poisson's Ratio show strong inflections at these depths. A probable reason for the latter is an increase in density associated with serpentinization, so that the fracture zones are actually of higher density than the surrounding rock.

In addition, the shear wave energy displays a filtering effect across the highly altered fracture zones. That is, both integrated energy content and center frequency drop across the fault zone.

Chemical analyses of cores, as well as nuclear and electrical logs allow us to characterize the change in porosity, alteration state and pore shape from the gabbro, which is highly fractured, to the serpentinite, in which most pore spaces are filled with plate-like and fibrous mixed-layer clays, talc and serpentine mineralization.

An acoustic attenuation model was developed in which the filter characteristics of the fracture zone are associated with venting, the differential loss of low-frequency energy, dependent on the dimensions of the available pore spaces, and fractures as they are filled with alteration minerals. In retrospect, the best way to have unambiguously identified the fracture zones at DSDP hole 556 was from shear wave filter characteristics (frequency-energy changes), rather than from Q , V_p/V_s , or Poisson's Ratio changes. This technique has important applications in the identification of fractured reservoirs.

The other Mid-Atlantic Ridge wells, DSDP 564 and 558 were logged over too short an interval to perform the above analyses.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) → Several previously recorded Deep Sea Drilling Project wells were re-examined to determine compressional and shear velocities in oceanic crust. Only 3 wells had sufficiently high quality sonic logs run in them to provide this information. Schlumberger then processed these 3 wells all in 17 million year old sea floor on the western flank of the Mid-Atlantic Ridge. Vp, Vs, Poisson's Ratio, amplitude and center frequency of the compressional and shear coda were calculated. The results were published by Diachek et al. Acoustical Soc. Amer. 1984.		

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